

Global Geology of Titan from Cassini data

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Introduction:

Titan has an active methane-based hydrologic cycle that has shaped a complex geologic landscape, making its surface one of most geologically diverse in the solar system. Despite the different materials, temperatures, and gravity fields between Earth and Titan, many surface features are similar between the two worlds and can be interpreted as products of the same geologic processes. We identified and mapped the major geologic units on Titan's surface using data from the Cassini spacecraft's RADAR (in Synthetic Aperture Radar, altimetry, and passive radiometry modes), Visual and Infrared Mapping Spectrometer (VIMS), and Imaging Science Subsystem (ISS). Synthetic Aperture Radar (SAR) is the dataset best suited for interpreting Titan's surface geology, as Titan's hazy atmosphere limits the detailed visual and infrared spectroscopy data but is transparent to RADAR's operating wavelength of 2.17 cm (Ku Band). However, correlations between the various datasets enabled us to map the global geology even where SAR was not available.

Geological mapping can place Titan's terrain types in stratigraphic order to constrain the relative importance and global distribution of various endogenic and exogenic processes. We defined six major geologic units based on SAR images and prior mapping as: plains, dunes, hummocky terrains, lakes, labyrinth terrains, and craters. Mapping the distribution of these units enables us to discern their latitudinal distribution, superposition relations, composition, and areal coverage, and the implications for Titan's geologic history. Determining the spatial and superposition relations between major geologic units reveals the likely temporal evolution of the landscape and gives insight into the interacting processes driving its evolution. We find that Titan's surface is dominated by sedimentary/depositional processes with significant latitudinal variation.